The need for, and benefits of, reduced aerodynamic base drag are so obvious, so compelling, and so widely recognized, that this goal often assumes the status of a hidden assumption. It therefore logically follows that all methods, or likely combinations of methods, known to people skilled in the art of aerodynamics for highway vehicles, should already be well researched and tested, and the results well documented.

Page 16 showing changes

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promoting attached flow over the bag". However it does not teach or suggest that the addition of vortex generators can produce significant additional drag reduction compared to the best configurations used without vortex generators (configuration 27 without vortex generators), or that adding vortex generators would allow using [a] significantly shorter bags.

IN THE CLAIMS:

Claims 1 through 4, 11, 12 and 14 through 18 are noted as withdrawn pending allowance of a generic claim.

PLEASE AMEND THE CLAIMS AS FOLLOWS:

Cancel Claims 5 through 10 and 13.

Showing changes to claims:

[5. An improved method for reducing the fluid-dynamic base drag of a bluff body, having a substantially flat base surface, substantially normal to the longitudinal centerline of said bluff body, which comprises;

using a plurality of vortex generators mounted in a cross stream array on the side, top, and bottom surfaces of said bluff body, ahead of the trailing edges of said bluff body, to generate an array of counter rotating streamwise vortices in the passing boundary layer fluid,

and using said vortex generators in combination with a set of three or more shortened boattail plates of predetermined length, mounted substantially perpendicular to the base surface of the bluff body, and adjacent to and inset a predetermined distance from said trailing edges of said bluff body,

thereby providing greater fluid-dynamic base drag reduction than either of the two component methods when used alone, and reducing the optimum length of said shortened boattail plates for maximum base drag reduction to less than half the length required for maximum base drag reduction when full length boattail plates are used without said vortex generators.

6. A device or apparatus for reducing the fluid-dynamic base drag of a bluff body having a substantially flat base surfaces, substantially normal to the longitudinal centerline of said bluff body, which comprises;

a plurality of vortex generators mounted in a cross stream array on the side, top, and bottom surfaces of said bluff body, ahead of said trailing edges of said bluff body,

and combined with a set of three or more shortened boattail plates of predetermined length, mounted substantially perpendicular to the base surface of the bluff body and inset a predetermined distance from the trailing edges of the bluff body, so that the rear edge of each of said shortened boattail plates intercepts the separated shear surfaces at the perimeter of the low pressure wake,

whereby the combined device provides greater fluid-dynamic base drag reduction than either of the two component devices when used alone, and where the optimum length for said shortened boattail plates is reduced to less than half the length required for maximum base drag reduction when full length boattail plates are used without said vortex generators.

7. The device of claim 6 wherein the bluff body is a land vehicle, and said vortex generators are omitted from the bottom surface of the vehicle, and the bottom boattail plate is also omitted.

8. The device of claim 6 wherein the vortex generators are V shaped low drag vortex generators.

9. The device of claim 7 wherein the highway vehicle includes a truck body with one or more swinging rear doors, or a rollup rear door.

10. The device of claim 6 wherein two or more sets of shortened boattail plates are mounted in tandem, with each set of said shortened boattail plates being of a predetermined length, and inset at a predetermined distance from the trailing edges of the bluff body, so that the rear edges of each set of said shortened boattail plates intercept the separated shear surfaces at the perimeter of the low pressure wake, to further reduce base drag.]

[13. The device of claim 6 wherein the cross sectional shape of the base surface of a bluff body is other than a rectangle, and said shortened boattail plates are made in the shape of the perimeter of said base surface but at a smaller size, while maintaining the

same predetermined inset distance from the edges of said bluff body, and the same predetermined length for said shortened boattail plates, relative to the direction of travel, so that the rear edge of each of said shortened boattail plates intercepts the separated shear surfaces at the perimeter of the low pressure wake.]

Rewritten claims are as follows:

19. A method for reducing the fluid-dynamic base drag of a bluff body moving through a fluid and creating, at the rear of the body, a low pressure wake with an outer perimeter, which bluff body has a substantially flat rear base surface, a pair of opposed side surfaces, opposed top and bottom surfaces all joined with said rear base surface at side, top and bottom trailing edges so as to form a box-like container, said method comprising the steps of:

mounting a plurality of side-by-side vortex generators in a linear array located on the side, top and bottom surfaces of said bluff body;

positioning said linear array ahead of the side, top and bottom trailing edges of said bluff body for generating counter rotating stream-wise vortices in a fluid boundary layer passing generally along said surfaces of said bluff body with separated shear surfaces turning sharply inward just aft of said trailing edges;

affixing, perpendicular to the base surface of the bluff body, four boattail plates, each having a front edge affixed to the base plate and a rear edge thereof defining a predetermined extension length for said plates, with said plates each substantially adjacent to and inset a predetermined distance from said side, top, and bottom trailing edges; and

sizing said boattail plates such that said rear edges thereof intercept the separated shear surfaces of said fluid layer at the outer perimeter of the low pressure wake in order to provide maximum fluid-dynamic base drag reduction for said bluff body.

20. A method for reducing the fluid-dynamic base drag of a land vehicle moving through air and creating, at the rear of the vehicle, a low pressure wake with an outer perimeter, which vehicle has a substantially flat rear base surface, a pair of opposed side surfaces and opposed top and bottom surfaces joined with said rear base surface at side, top and bottom trailing edges so as to form a box-shaped rear end for the vehicle, the method comprising the steps of:

mounting a plurality of side-by-side vortex generators in a linear array located on the sides, and top surface of said vehicle;

positioning said linear array ahead of the side and top trailing edges of said vehicle for generating counter rotating stream-wise vortices in a boundary layer passing generally along said surfaces of said vehicle with separated shear surfaces turning sharply inward just aft of said trailing edges;

affixing, perpendicular to the base surface of the bluff body, boattail plates, each having a front edge affixed to the base surface and a rear edge thereof defining a predetermined extension length for said plates, with said plates each substantially adjacent to and inset a predetermined distance from said side and top trailing edges; and

sizing said boattail plates such that said rear edges thereof intercept the separated shear surfaces of said fluid layer at the outer perimeter of the low pressure wake in order to provide maximum fluid-dynamic base drag reduction for said land vehicle.

21. The method of claim 20 wherein the vehicle has a forward end and the individual vortex generators of said linear array are V shaped, low drag vortex generators, and said method comprises the further steps of:

mounting the open end of the V shaped vortex generators toward the oncoming air flow of the passing boundary layer; and

mounting the closed end of said V shaped vortex generators toward the rear of said vehicle.

22. The method of claim 20 wherein said vehicle includes a roadway truck body subject to rules establishing a two foot limit for a rearward extension beyond the trailer underride bars and provided with one or more swinging rear doors divided vertically lengthwise at about the center of the rear base surface, wherein said affixing step further comprises:

hinging said plates to said doors such that opening of the vehicle doors allows said boattail plates to separate and swing away with the swinging doors of said land vehicle.

23. A method for reducing the fluid-dynamic base drag of a bluff body

in accordance with claim 22, said method further comprising the step of:

positioning the predetermined inset distance where both side and top boattail plates are affixed to the rear base surface to be about 8 to 9 percent of the width or height of that rear base surface, whichever is less; and

said sizing step comprises setting a predetermined extension length for said boattail plates to be about 1/6 the lesser of the width or height of that rear base surface.

24. A method for reducing the fluid-dynamic base drag of a bluff body in accordance with claim 22, said method further comprising the step of:

positioning the predetermined inset distance where both side and top boattail plates are affixed to the rear base surface to be about 4 to 5 percent of the width or height of that rear base surface, whichever is less; and

said sizing step comprises setting a predetermined extension length for said boattail plates to be about 1/8 the lesser of the width or height of that rear base surface.

25. A method for reducing the fluid-dynamic base drag of a bluff body in accordance with claim 20 wherein said boundary layer has a given local thickness adjacent the trailing edges, said method further comprising the step of:

selecting the thickness of said vortex generators such that said generators extend from the top and sides of said bluff body in the range of 1/4 to 1/5 said local thickness for said boundary layer.

26. Apparatus for reducing the fluid-dynamic base drag of a bluff body moving through a fluid and creating, at the rear of the body, a low pressure wake having an outer wake perimeter, which bluff body has a substantially flat rear base surface, a pair of opposed side surfaces, and opposed top and bottom surfaces all joined with said rear base surface at side, top and bottom trailing edges, respectively, so as to form a box-like container, said apparatus comprising:

means positioning side-by-side vortex generators in a linear array ahead of the two side, top and bottom trailing edges of said bluff body for generating counter rotating stream-wise vortices in a fluid boundary layer passing generally

along said bluff body and creating from said layer separated shear surfaces which turn sharply inward aft of said trailing edges;

four boattail plates inset and affixed a predetermined distance from the top and side trailing edges; and

rear edges on said boattail plates sized to intercept the separated shear surfaces of said fluid layer at the outer perimeter of the low pressure wake, thereby providing maximum fluid-dynamic base drag reduction for said body.

27. The apparatus in accordance with claim 26 wherein the bluff body is a land vehicle moving in air, which vehicle has only three boattail plates attached adjacent the top and opposed side trailing edges; and

three linear arrays of vortex generators, one array each associated with one each of said boattail plates.

28. The apparatus of claim 27 wherein the vortex generators are V shaped low drag vortex generators having an open end and a pointed end, and said apparatus further comprises:

said V shaped vortex generators in said linear arrays are positioned with said open end facing toward a forward end of said vehicle; and the pointed end of said V shaped vortex generators pointed toward the rear of said vehicle.

29. The apparatus of claim 27 wherein said vehicle includes a truck trailer body with a rear opening into said box-like container, and further comprising:

boattail plate hinging means allowing said plates to swing clear from said rear opening for said trailer body.

30. The apparatus of claim 27 wherein said trailer body has a pair of swinging rear doors vertically divided lengthwise top to bottom at about the center of the base surface, said method further comprising:

means dividing the top boattail plate at the point of division of the vehicle's rear swinging doors such that opening of the vehicle doors allows said boattail

plates to separate and swing away together with the swinging doors of the trailer body.

31. Apparatus for reducing the fluid-dynamic base drag of a bluff body in accordance with claim 26, and further comprising:

means positioning said affixing means at a predetermined inset distance of about 8 to 9 percent of the lesser of the height or width of said rear base surface.

32. Apparatus for reducing the fluid-dynamic base drag of a bluff body in accordance with claim 26, said apparatus further comprising:

a front edge surface for each of said boattail plates; and

means hinging said front edge of said boattail plates to said base surface at said inset location.

33. Apparatus for reducing the fluid-dynamic base drag of a bluff body in accordance with claim 26 wherein said boundary layer has a given local thickness, said apparatus further comprising:

a thickness height for said generators in the range of 1/4 to 1/5 said local boundary layer thickness.

34. The apparatus of claim 26 wherein the cross sectional shape of the base surface of a bluff body has a perimeter shape other than a rectangle, and further comprising:

said boattail plates shaped with the perimeter of said base surface but at a smaller size, while maintaining the same predetermined inset distance from the edges of said bluff body and a similarly shaped rear edge for said boattail plates located to intercept the separated shear surfaces of said fluid flow at an outer perimeter of the low pressure wake.